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... THE ...

AMERICAN FERTILIZER

" That man is a benefactor to his race who makes two blades of grass to grow where but one grew before."

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The Relationship of Liming to Soil Fertilization*

By JACKSON B. HESTER

Soil Technologist, Department of Agricultural Research, Campbell Soup Company, Riverton, N. J.

THE beneficial aspects of liming acid soils have been known since the advent of modern man. Furthermore, the profits obtained from liming have been pointed out on many occasions, and again, the soil areas requiring lime have been fairly well mapped, yet a greater portion of the agricultural soils in the eastern states are extremely deficient in lime. Soil analyses reveal that crop production on between 75 and 80% of the soils in the eastern and southern states would be benefited by lime, yet some of these states use as little as an average of one pound of lime per acre on the cultivated land. Knowing the effort that has been made to encourage the proper use of liming materials, these facts hardly seem possible. In order to try and explain some of the beneficial aspects of liming acid soils in its relation to soil fertility, this paper is given.

While innumerable experiments with liming materials have been carried out by competent scientists, and many of the functions learned, the total influence of liming acid soils has yet to be elucidated. However, many of the factors are known and some of the pertinent ones will be discussed. First, liming soils increases the calcium and magnesium content; second, precipitates harmful quantities of aluminum, iron, and manganese out of the soil solution; third, increases the availability of phosphorus; fourth, stimulates the growth of beneficial micro-organisms; fifth, improves the physical aspects of the soil; sixth, increases the quantity of calcium and magnesium in the crop for animal consumption; etc.

* Paper given before the 22nd Annual Convention of the National Lime Association in Chicago, May 23, 1940.

To adequately develop any of these points would require a lengthy manuscript, so this discussion must be confined to merely calling attention to some points, refreshing your memory on others, and developing still others more fully.

Liming Soils Increases the Calcium and Magnesium Content

Soils are composed of three main mineral constituents, sand, silt, and clay. The proportion of these materials present determines the texture of the soil. Since the amount of clay in a soil largely determines the absorption capacity of the soil for lime, a chart has been constructed giving the proportion of these materials found in the various soils (see Fig. 1). Without further explanation about this chart, the figures in Table I will be discussed.

Sands carry approximately 70 tons of clay and 12 tons of organic matter per acre 7 inches,

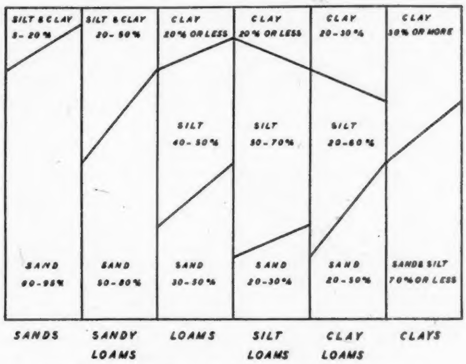

FIG. 1. Sand, silt, and clay in various soil types.

while the heavier soils carry much more, up to 300 or 400 tons per acre. Since the liming material is used to neutralize the acidity of these two constituents, an understanding of the individual characteristics of the materials are helpful.

The results in Table II show that the acid strength of clay and organic matter varies, depending upon the mineral and organic matter contents. For example, the ultimate acid strength (clay free of calcium and magnesium) of Norfolk clay is pH 5.1 while that of Bladen is 3.9. Furthermore, the ultimate acid strength of humus is even greater than that of clay, giving a pH value as low as 3.2. Thus, the pounds of calcium oxide necessary to neutralize a ton of either material varies. It is sufficient to say, however, that 12 pounds of calcium oxide will neutralize the acid in a ton of clay and 70 pounds that in a ton of humus. From these results Table III shows the amount of lime necessary to neutralize the acidity in one acre of ground to the seven-inch depth provided the clay and organic matter is completely devoid of available calcium and magnesium. This table shows better the amount of calcium and magnesium in terms of calcium oxide that would be found in the replaceable state if the soils had a neutral pH value.

Table I

The Approximate Clay and Organic Matter Content of Various Soil Types

	Tons per Acre					
	Sands	Sandy Loams	Loams	Silt Loams	Clay Loams	Clays
Clay	70	100	150	150	250	350
Organic matter..	12	17	25	25	35	45

Table II

Lime Necessary to Neutralize the Acid in the Clay and Organic Matter of Various Soil Types (Pounds CaO per Ton of Colloid)

	pH Clay Acid	Clay	pH Humic Acid	Humus
Norfolk	5.1	12	3.6	81
Bladen	3.9	18	3.5	70
Portsmouth	3.8	16	3.2	95

Table III

Calcium Oxide Necessary to Neutralize the Acid in Average Soil Types*

	Sands	Sandy Loams	Loams	Silt Loams	Clay Loams	Clays
Clay	840	1,200	1,800	1,800	3,000	4,200
Organic matter	840	1,190	1,750	1,750	2,450	3,150
Total CaO.....	1,680	2,390	3,550	3,550	6,450	7,350

* Pounds per two million.

From the present state of acidity of the average Coastal Plain soil and the present rate of liming, it is not likely that many of these soils will have a pH value near neutral for some time to come. It is neither necessary nor desirable to lime all of the soils to the neutral pH value. A Sassafras sandy loam soil (pH 5.45) on which tomatoes were grown was limed with 1,500 pounds of hydrated lime in the spring of 1938 and again with 1,500 pounds in 1939 and yet this soil only had a pH value of 6.9 in the fall of 1939. Consequently it is not likely that many soils will be overlimed.

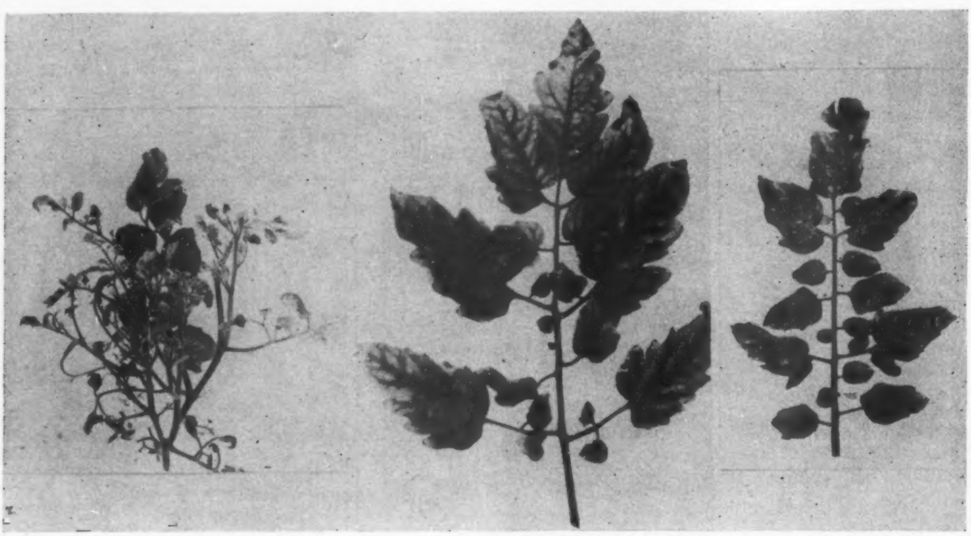

FIG. 2. Calcium deficiency. FIG. 3. Magnesium deficiency. FIG. 4. Manganese toxicity.

In this connection, pictures giving the symptoms of calcium and magnesium deficiency on tomatoes may be interesting (see Fig. 2 and 3). Magnesium deficiency has been noted frequently in the eastern states but calcium deficiency, as such, is not as prevalent. The reason that true calcium deficiency has not been noted so frequently is because of the solubility of aluminum, iron, and manganese in the soils of low pH value. Before the soil is completely deficient in calcium, it becomes extremely acid and aluminum, iron, and manganese become mobile and soluble.

Lime Precipitates Aluminum, Iron and Manganese

The pH value at which harmful quantities of aluminum, iron, and manganese become soluble and are a factor in crop production is shown in Table IV. The pH value at which these compounds become soluble is controlled by the organic matter content and mineral composition of the soil colloid. It is difficult to describe the toxic effect of these different compounds upon the plant because they are associated with the precipitation of the phosphorus in the soil solution. An illustration of manganese toxicity is shown in Fig. 4. Since iron and aluminum precipitate phosphorus from solution and the compounds thus formed are not readily soluble at a pH value where plants grow, a discussion of the reaction of these compounds in the soil may be helpful in explaining the reaction of liming materials on the soil.

Increases the Availability of Phosphorus

It must be appreciated that the combination of phosphorus with iron, aluminum, and manganese in the soil must be of extreme variation since the conditions under which they are precipitated are so varied. However, an insight into the action of certain of these combinations may help to elucidate the subject. Table V gives the pH value at which certain of the compounds of phosphorus may become soluble. Furthermore, Table VI shows the availability of certain of these compounds to tomatoes, potatoes, and lima beans grown in pure sand. These data show that when iron and aluminum phosphate are formed in the soil, the plant's ability to obtain phosphorus from the combination is unlikely.

For a mental picture of what may happen, at least temporarily, to phosphorus when added to soils of various pH value, Fig. 5 has been constructed. Attention should be called to the fact that the final state of added phosphorus to soils high in iron and aluminum is the most stable state, iron and aluminum phosphate. Consequently, it is the arresting of this final state that liming influences. From these data it can be readily seen that for maximum availability of phosphorus, acid soils must be limed to the proper pH value wherever possible. From the standpoint of phosphorus availability

Table V

Solubility of Phosphate Compounds

Compounds	Slowly Soluble Below pH	Slightly Soluble Below pH
Iron phosphate............	4.0	5.0
Aluminum phosphate......	5.0	5.5
Manganese phosphate......	5.5	6.0
Tri-calcium phosphate.....	6.0	7.0
Tri-magnesium phosphate..	6.5	7.0
Di-calcium phosphate......	6.5	7.0
Mono-calcium phosphate...	7.0	7.5
Rock phosphate...........	4.2	5.0

Table VI

*Availability of Phosphate Compounds to Plants in Sand**

Compounds	Tomatoes	Potatoes	Lima Beans
Iron phosphate............	1	14	52
Aluminum phosphate......	24	90	98
Manganese phosphate......	83	122	0
Tri-calcium phosphate.....	145	110	87
Tri-magnesium phosphate..	301	320	319
Di-calcium phosphate......	296	302	307
Mono-calcium phosphate...	320	307	371
Rock phosphate...........	5	31	33

* Milligrams P_2O_5 absorbed by plants from equal amounts of P_2O_5 applied as the above compounds.

Table IV

pH Value in Various Soil Types at Which Aluminum, Iron or Manganese Becomes Soluble

		pH Value								
		Aluminum			Iron			Manganese		
Soil Type	Per Cent Organic Matter	High	Medium	Low	High	Medium	Low	High	Medium	Low
Portsmouth*	13.5	4.0	4.8	5.4						
Sharkey*†		3.0	3.5	4.0	3.0	3.4	3.6			
Elkton*†	5.5	4.8	5.0	5.4	4.8	5.0	5.2			
Bladen*†	1.7	4.2	4.9	5.1						
Sassafras*‡	4.7	4.8	5.4	5.6	4.8	5.2	5.4	4.8	5.2	5.6
Norfolk*†	1.0	5.5	5.6	5.7	5.0	5.2	5.5			
Nipe†‡								5.0	5.4	5.5

* Soil high in active aluminum.
† Soil high in active iron.
‡ Soil high in active manganese.

and crop production, the data in Fig. 6 are given. These results show that liming and phosphorus availability are closely related. See Fig. 7, 8 and 9. In each case, liming has been entirely necessary for maximum crop production. Consequently, on acid soils, the economic production of a crop like tomatoes rests entirely with soil liming. In this connection an experiment was conducted, using tomatoes as

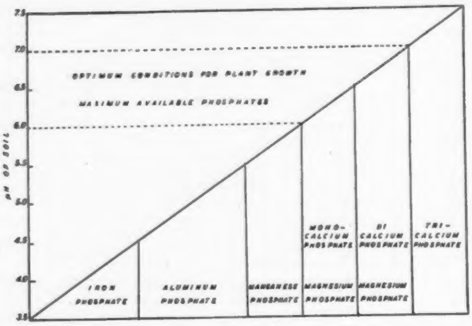

FIG. 5. Phosphate combinations predominately formed at the various pH values.

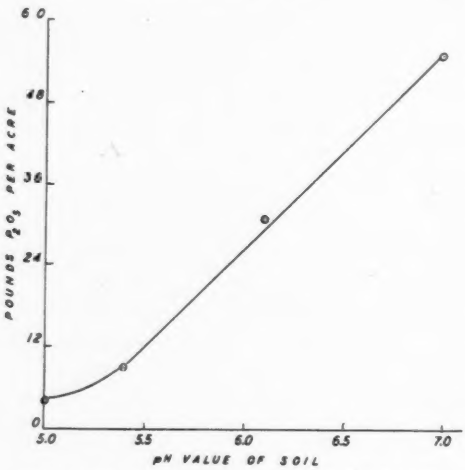

FIG. 6. Influence of soil acidity upon the availability of phosphorus in the soil.

the test crop on an acid Sassafras soil. Using a large amount of phosphorus, a fair yield was obtained on the acid soil, but using lime and a medium amount of phosphorus, a better yield was obtained. Lime not only increases the availability of phosphorus but also stimulates the activity of beneficial micro-organisms.

Stimulating the Growth of Beneficial Micro-organisms

Liming acid soils increases the activity of beneficial micro-organisms from 2 to 4 times. Liming an acid soil (pH 5.45) with 1,500 pounds of hydrated lime on April 14th increased the nitrate nitrogen formed in the soil from 14 to 33 pounds per acre by May 26th, and with 3,000 pounds of lime to 66 pounds of nitrate nitrogen per acre. Thus, with the increased carbon dioxide formation, more plant nutrients were brought into solution for crop

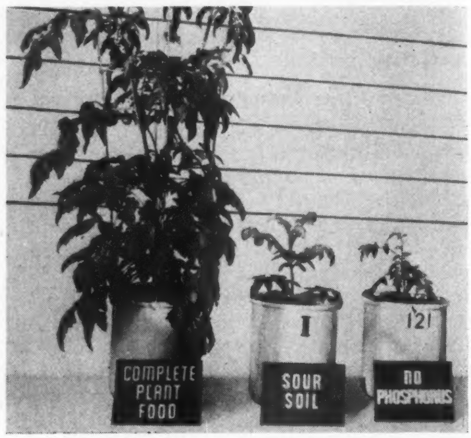

FIG. 7. Proper liming of extremely acid soils is necessary for utilization of fertilizer materials.

FIG. 8. Influence of lime on the early growth of tomatoes.

utilization. Furthermore, not only the formation of more nitrates for crop use but the more desirable nitrogen-fixing micro-organisms are stimulated. Indications are that soils derived from limestone are richer in organic matter than soils derived from sandstone. It is believed that this is due to the fact that soils derived from limestone produce more plant

(Continued on page 24)

The 1940 N. F. A. Convention

Industry Prepared to Meet War Conditions. Officers and Directors Elected.

AT a convention attended by more than 400 fertilizer executives and agricultural leaders, the National Fertilizer Association, at its sixteenth annual meeting, pledged cooperation in the national preparedness plans which are now being developed. Meeting at White Sulphur Springs on June 3rd, 4th and 5th, the industry took a survey of its present status and made plans to meet new situations as they may arise.

In his address "A Century of Plant Food Progress" Charles J. Brand, Executive Secretary of the Association, emphasized the steps which have been taken to avoid a shortage of vital fertilizer materials. Mr. Brand stated that in an emergency the nitrogen industry in America could increase capacity to provide for all domestic needs. He also pointed out that, whereas in 1914 pyrites and by-products produced 97.8 per cent of the sulphuric acid in this country, at the present time 66 per cent of the acid comes from domestic sulphur, 17 per cent from pyrites and 17 per cent from smelter fumes.

Mr. Brand gave especially high praise to the development of the potash manufacturing industry in this country. He contrasted the situation in 1914, when the shortage of European potash caused price increases of several hundred per cent, with the conditions of the past year when the present world war found this country with adequate sources of this material, with the result that prices remained stable.

Among the other speakers were Dr. Allan A. Stockdale, of the National Association of Manufacturers who told the convention that no economic planning authority could have ever foreseen, planned, and organized such an amazing industrial program as has been that of America in the last century.

He added that dictatorship would have limited participation of thought and effort. Regulation and regimentation would have killed initiative, he said, and the State supreme over the individual would have resulted in politics instead of progress.

"Teamwork in Farm Research" was discussed by Dr. W. H. Martin, dean and director, Agricultural Experiment Station, New Brunswick, New Jersey. Dr. Martin pointed out that the convention was meeting on the one hundredth anniversary of the announcement of the mineral theory of feeding plants. He said that the agricultural experiment stations and agricultural chemistry came into existence about the same time and in response to essentially the same need—a demand for exact information about the chemistry of the soil and for materials with which to enrich the soil and produce more abundant harvests. He stated that the industry and the agricultural experiment stations had a common goal.

Election of Officers and Directors

The members attending the convention elected the following directors-at-large to serve for the term ending in 1943:

A. L. Ivey, Virginia-Carolina Chemical Corp., Richmond, Va.

M. H. Lockwood, Eastern States Farmers' Exchange, Springfield, Mass.

H. Albert Smith, The Smith Agricultural Chemical Co., Columbus, Ohio.

Louis Ware, International Agricultural Corp., New York City.

Directors elected by districts for the 1940-1943 term were:

District 1. L. E. Britton, Consolidated Rendering Co., Boston, Mass.

District 2. George Cushman, Long Island Produce & Fertilizer Co., Riverhead, N. Y.

District 3. Wm. B. Tilghman, Wm. B. Tilghman Co., Salisbury, Md.

District 4. R. B. Douglass, Smith-Douglass Co., Norfolk, Va.

District 6. H. B. Baylor, International Agricultural Corp., Atlanta, Ga.

District 12. Weller Noble, Pacific Guano Co., Berkeley, Calif.

To fill a vacancy, Lionel Weil, Weil's Fertilizer Works, Goldsboro, N. C., was elected to represent District 4 for the term ending in 1942.

At the close of the convention, the new Board met and re-elected the present officers to serve for the year 1940-1941: President, John E. Sanford, Armour Fertilizer Works, Atlanta, Ga.; Vice-President, John A. Miller, Price Chemical Co., Louisville, Ky.; Executive Secretary and Treasurer, Charles J. Brand, Washington, D. C.

LIME SALES IN 1939

Agricultural lime sales in 1939, according to the U. S. Bureau of Mines, amounted to 362,335 short tons, valued at $2,214,759. This represented a small decline from 1938, when sales totaled 364,312 tons with a valuation of $2,376,108. The average value per ton declined from $6.52 to $6.11.

CANADIAN FERTILIZER FOREIGN TRADE INCREASED

Preliminary Canadian official import statistics for the first quarter of 1940 show an increase in the total value of imports of fertilizers to $586,849 (Canadian dollar) from Canadian $356,030 in the corresponding period of 1939. Potash salts and sodium nitrate accounted for the gain.

Exports of fertilizers from Canada rose in value to Canadian $2,957,975 in early 1940 from Canadian $2,852,473 in the first quarter of 1939. The decline in value of the Canadian dollar probably accounted for the slight increase. The volume of 120,106 short tons for 1940 was about 300 tons less than that reported for 1939.

A decline in the volume of exports of ammonium sulphate was offset by increased shipments of fertilizer mixtures.

April Superphosphate Production

April was the eighth consecutive month in which superphosphate production was larger than in the corresponding month of the preceding year. It was somewhat below April, 1937, but with that exception production was the largest for any April in many years. The small seasonal decline from March to April was much less than that which usually occurs. Output at plants in the southern area, according to reports by acidulators to The National Fertilizer Association, was substantially larger than a year ago while a more moderate increase took place in production at northern plants. Total output in the first four months of the year, from January through April, amounted to 1,296,000 tons, an increase of 24 per cent over the corresponding period of last year. There was a 22 per cent increase for this period in the north while a rise of 26 per cent was reported by southern acidulators.

Stocks showed a sharp decline in April, following the usual seasonal pattern. Total stocks at the close of the month were 11 per cent larger than a year earlier, with a 1 per cent increase in stocks of bulk and a much larger increase of 29 per cent in the amount of superphosphate in base and mixed goods. Stocks of bulk in the northern area were somewhat smaller than a year ago.

Total reported shipments in the January-April period were moderately larger than in the first four months of 1939, with the larger gain taking place in the south. Increases over last year were reported in all classes of shipments.

Superphosphate Production, Shipments and Stocks for April and January-April, 1940 and 1939

Expressed Throughout in Equivalent Tons of 16% A.P.A. Based on Reports by Acidulators to The National Fertilizer Association

April	United States 1940	United States 1939
Stocks—First of month:		
Bulk superphosphate	952,512	948,853
Base & mixed goods	782,151	666,523
Production:		
Bulk superphosphate	275,113	220,690
Base & mixed goods	13,195	16,013
Total Production	288,308	236,703
Other receipts*	33,107	34,553
Book adjustments	—2,134	+664
Total Supply	2,053,944	1,887,296
Shipments:		
Superphosphate:		
To mixers	194,473	212,480
To other acidulators	65,285	68,893
To consumers, etc.	188,762	167,776
Total Superphosphate	448,520	449,149
Base & mixed goods	405,103	358,256
Total Shipments	853,623	807,405
Stocks—End of month:		
Bulk superphosphate	698,084	689,242
Base & mixed goods	502,237	390,649
Total Stocks	1,200,321	1,079,891

Accumulated Production and Shipments for January-April

	United States 1940	United States 1939
Production:		
Bulk superphosphate	1,245,593	995,692
Base & mixed goods	50,104	45,684
Total Production	1,295,697	1,041,376
Shipments:		
Superphosphate:		
To mixers	587,036	553,545
To other acidulators	190,298	183,908
To consumers, etc.	392,384	379,521
Total Superphosphate	1,169,718	1,116,974
Base & mixed goods	761,062	743,773
Total Shipments	1,930,780	1,860,747

* Includes inter-company transfers.
Base includes wet and/or dry base.

May Tag Sales

Total fertilizer sales as indicated by the sale of tax tags in the 17 reporting states amounted to 406,474 tons in May, according to reports by state control officials to The National Fertilizer Association. This represented a 4 per cent increase over last year and a 23 per cent increase over May, 1938. The gain over last year was due to larger sales in the south, where weather conditions resulted in a late season. Aggregate sales in the midwest were slightly below last year, although substantially larger than two years ago.

The principal increase over May, 1939, was in Mississippi. Other states to report increases were Virginia, Alabama, Tennessee, Arkansas, Louisiana, Texas, Kentucky, and Missouri.

January-May sales in the southern states were slightly below the corresponding period of last year but this was more than offset by an increase in the midwest. Combined sales in both areas were 21,500 tons, about one-half per cent, larger than a year ago. Declines from 1939 in Virginia, the Carolinas and Oklahoma were not quite offset in the southern group by increases in the other eight states. Sales in Arkansas and Texas this year will be the best by far for any year since 1930. All five of the midwestern states have reported increases over 1939 for the five-month period.

Total sales in the 17 states in the first 11 months of the current fiscal year, from July through May, were 52,000 tons larger than in the similar period of 1938-1939. Sales in 15 states, excluding Virginia and North Carolina, were 204,000 tons larger than last year. The decline in tobacco acreage has had a marked effect on fertilizer tonnage. Sales in both areas have been below the 1936-37 results. With that exception they are best since 1930.

TAG SALES IN JULY-MAY PERIODS

	1939-40 in Per Cent of 1938-39	1939-40	1938-39	1937-38	1936-37
12 Southern States	100	4,810,000	4,798,000	4,625,000	5,177,000
5 Midwestern States	108	534,000	494,000	522,000	544,000
17 States	101	5,344,000	5,292,000	5,147,000	5,721,000

FERTILIZER TAX TAG SALES*

Compiled by The National Fertilizer Association

	May				January-May			
	1940				1940			
	Per Cent of 1939	Tons	1939 Tons	1938 Tons	Per Cent of 1939	Tons	1939 Tons	1938 Tons
South:								
Virginia†	108	33,655	31,302	20,206	94	282,046	301,400	290,281
N. Carolina	74	51,446	69,414	37,483	87	936,002	1,075,381	971,131
S. Carolina	80	28,596	35,864	37,385	100	618,254	620,735	603,266
Georgia	92	39,486	42,997	45,895	106	697,010	658,150	683,866
Florida†**	85	48,456	57,322	33,493	107	262,500	246,222	243,947
Alabama	114	45,650	40,040	54,450	103	551,650	537,440	511,050
Mississippi	546	40,900	7,488	16,350	170	282,170	264,863	289,704
Tennessee†	115	25,349	21,961	16,331	103	117,803	113,915	109,185
Arkansas‡	592	7,100	1,200	4,600	145	93,050	64,100	61,600
Louisiana†	363	3,900	1,075	5,900	108	131,311	121,876	120,072
Texas†	115	4,025	3,495	3,508	127	101,581	80,169	71,552
Oklahoma	90	139	155	160	88	5,432	6,183	6,545
Total South	105	328,702	312,313	275,761	100	4,078,809	4,090,434	3,962,199
Midwest:								
Indiana	88	39,706	45,050	31,944	112	175,082	156,658	127,089
Illinois	98	9,525	9,687	8,252	122	36,161	29,575	30,205
Kentucky	118	28,147	23,758	15,508	102	87,241	85,581	91,135
Missouri	...	389	39	48	125	26,159	20,866	24,716
Kansas	4	5	135	55	183	2,658	1,455	3,539
Total Midwest	99	77,772	78,669	55,807	111	327,301	294,135	276,684
Grand Total	104	406,474	390,982	331,568	100	4,406,110	4,384,569	4,238,883

* Monthly records of fertilizer tax tags are kept by state control officials and may be slightly larger or smaller than the actual sales of fertilizer. The figures indicate the equivalent number of short tons of fertilizer represented by the tax tags purchased and required by law to be attached to each bag of fertilizer sold in the various states.

† Cottonseed meal sold as fertilizer included.

‡ Excludes 18,000 tons of cottonseed meal for January-May combined, but no separation is available for the amount of meal used as fertilizer from that used as feed.

** Includes 20,126 tons of phosphatic and lime materials for January-May, 1940.

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Principal Articles in This Issue

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Potash Prices for 1940-41 Announced

The Potash Company of America has announced its schedule of prices for potash salts for fertilizer use during the season ending May 31, 1941. Muriate of potash is priced at 53½ cents per unit K_2O for both the 50 per cent and the 60 per cent products. Manure salts, run-of-mine grade are listed at 60 cents per unit K_2O. Prices for muriate are the same as last year, while for manure salts there has been a slight increase.

The above list prices are ex-vessel at the customary ports. However, buyers have the option to purchase their requirements f.o.b. Carlsbad, New Mexico at a reduction of 11.2 cents per unit. This would make the net price on high grade muriate about $7.00 per ton less than the net price ex-vessel ports. According to a map issued by the company, it will be cheaper to purchase ex-vessel in New England, New York, the middle and south Atlantic states as far west as the Appalachian Mountains, and in the southern portions of the Gulf states.

A seasonal discount of 8 per cent is allowed on orders placed and accepted by July 10, 1940, for delivery in equal monthly quantities from July 1, 1940 to January 31, 1941. On completion of delivery, by January 31, 1940, of the entire tonnage contracted for, an additional 4 per cent discount will be allowed.

On orders accepted from July 10, 1940 to October 31, 1940, for delivery in equal monthly quantities from November 1, 1940 to January 31, 1941, there will be a discount of 4 per cent, with an additional 2 per cent upon completion of the contract.

On orders placed after November 1, 1940, the list prices will apply.

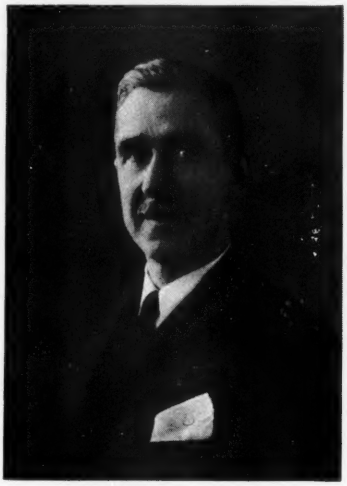
The prices quoted are guaranteed against reduction until May 31, 1940, but it is stipulated that this guarantee will not apply to any change in terms or conditions imposed by Federal authority.

FERTILIZER EMPLOYMENT

During March and April, employment in fertilizer plants was maintained at about the 1923-1925 level which is the standard adopted by the U. S. Bureau of Labor Statistics. March showed 100.8 per cent and April 99.9 per cent. Payrolls, however, have increased materially. March payrolls were 112.7 per cent and April payrolls 136.2 per cent of the 1923-1925 normal.

JEFFREY APPOINTS MERCIER

The Jeffrey Mfg. Co., Columbus, Ohio, has announced the appointment of Stanley M. Mercier to the position of Chief Engineer of the Conveyor Division. Mr. Mercier, who entered on his new duties on April 1st, will direct all conveyor engineering and engineering sales activities.



STANLEY M. MERCIER

Born and educated in England, Mr. Mercier has enjoyed a varied experience in industrial and construction engineering, design and sales, and has been associated with some of the outstanding construction operations in this country during the last decade.

Obituary

E. L. GREGORY

On May 28th, one of the pioneers in the Tennessee phosphate industry, Hon. E. L. Gregory, died at his home in Ardmore, Okla. He was in his 86th year, having retired from business several years previous because of ill health.

Mr. Gregory was born at Trivoli, Ill. and moved to Nashville, Tenn. in early life. Graduating from Vanderbilt University in 1875, he practiced law in that city until 1897. Moving to Mt. Pleasant, he became prominently engaged in the phosphate business in Maury and Hickman Counties. He was connected with the firms of Ruhm & Gregory, Cloverine Fertilizer Co., Mt. Pleasant Real Estate Co., France & Co., and was co-founder of the Mt. Pleasant record.

In 1910 he sold his phosphate interests to the International Agricultural Corporation and moved to Oklahoma where he was engaged in the newspaper business at Lawton and later at Ardmore.

In addition to his widow, he is survived by two daughters, Mrs. Kelsey Polk of Ardmore, Oklahoma and Mrs. S. Locke Breaux, Jr., of San Francisco, Cal., two grandsons, four granddaughters, two great-grandchildren, and by a number of nephews and nieces, among whom are John Ruhm, Jr., of Mt. Pleasant, and H. D. Ruhm of Columbia, both of the Ruhm Phosphate & Chemical Co., and Mrs. John S. Frierson, Jr., of Mt. Pleasant.

GUY O. McPHAIL

Guy O. McPhail, manager of the Henderson, N. C., office of the American Agricultural Chemical Company, died on May 12th from injuries received in an automobile accident. Mr. McPhail was formerly assistant manager at the Atlanta office of the company, and in 1935 was promoted to take charge of the Henderson branch.

ISAAC W. READ

Isaac W. Read, former president of the Southern States Phosphate & Fertilizer Co., died at his home in Augusta, Ga., on April 15th. Born in Nashville, Tenn., on June 19, 1876, Mr. Read moved to Augusta in 1912 to fill the position of secretary and treasurer with the Southern States Phosphate & Fertilizer Co. He was elected vice-president in 1918 and president in 1928, which position he held until his retirement five years ago. For many years he was a regular attendant at the meetings of the National and Southern Fertilizer Associations and had a wide circle of friends throughout the industry.

EDWARD D. SMITH, JR.

Edward D. Smith, Jr., treasurer of Independent Mfg. Co., renderers and fertilizer manufacturers, Philadelphia, died on May 22d. Mr. Smith had been connected with the business for many years, first as superintendent and, since 1927, as treasurer of the company. Funeral services were held on May 27th.

CUBAN FERTILIZER SALES INCREASE

There was a slight decline in the sales of fertilizers in Cuba during April, although the trade was maintained at a higher level than that of April, 1939, according to the reports of dealers in Havana, who also have estimated that the volume of business done during the first calendar quarter of the present year was greater than during the corresponding period of last year. The movement of fertilizers for use on the next pineapple crop has commenced and will last for approximately three months.

The closing of normal sources of supply for certain fertilizer materials is beginning to be felt. Some dealers are understood to be making efforts to obtain requirements of potash from France and Spain.

There has been a report that burdensome regulations connected with the importation of sulphur for agricultural purposes may be removed within the near future. At the present time, sulphur, which is regarded as an explosive, may be imported only under an import license obtained from the Department of Defense.

The table that follows is an incomplete record of fertilizer imports as compiled from ships' manifests. While strict accuracy is not claimed, the figures will afford an approximate index of the movement of the principal fertilizer materials during the past two years.

Fertilizer Imports Into Cuba in Metric Tons

Item	1938	1939
Chemical fertilizer	5,219	9,302
Superphosphates	6,176	6,984
Ammonium phosphates	410	2,095
Ammonium sulphate	4,640	5,855
Potassium sulphate	3,436	1,040
Sodium nitrate	999	1,277
Potassium nitrate	....	45
Calcium nitrate	....	81
Potassium chloride	1,198	1,931

SPANISH NITROGEN INDUSTRY TO BE ESTABLISHED

With a view to creating a domestic manufacturing industry not only to supply the Spanish military plants engaged in the production of munitions but to make the country independent of foreign supplies of artificial or synthetic fertilizers, Spain, through the Ministry of Industry and Commerce, issued a decree on February 10, 1940, declaring that the production of synthetic nitrogen is of national interest and that a nitrogenous industry established according to the law will enjoy certain specified rights. Among these privileges are "the right to forceful expropriation of the lands necessary for its installation, reduction of taxes up to 50 per cent, and reduction in customs duties for the importation of machinery and equipment for its installation when such are not manufactured in Spain."

Other sections of the law set forth the manner of submitting petitions to the Government for those who wish to take advantage of the benefits, and include other requirements under the law. Guarantee stipulated in one of the articles is "being applied as well to industries already established, to be rehabilitated or enlarged, when such changes presume a true alteration with an obvious interest in the economic life of the nation."

NEW STEPHENS-ADAMSON CIRCULAR

Stephens-Adamson Mfg. Co., Aurora, Ill., has issued a new folder Bulletin 240, covering box car loaders and pilers. This apparatus is used to fill box cars with bulk material such as lime, superphosphate, etc., and also to pile such materials for storage. This line of machines is built to handle from 100 to 350 tons of material per hour. Copies of this bulletin will be sent on request.

FERTILIZER MATERIALS MARKET

NEW YORK

Interest Centers on Fertilizer Convention at White Sulphur Springs. Until New Prices are Announced, Little Activity in Materials.

Exclusive Correspondence to "The American Fertilizer."

NEW YORK, June 4, 1940.

The main interest in the fertilizer industry is centered this week at the annual convention of the National Fertilizer Association now taking place at White Sulphur Springs, West Virginia. With a large number of the manufacturers and primary materials producers attending the convention, there is small activity to be noted in the fertilizer field at this time, and buyers are marking time until the announcement of new seasonal prices on all materials. The general outlook for the coming fertilizer year shows a bearish feeling on organic materials, while the chemical fertilizers are expected to be in a strong position with small increase, if any, over the present price schedules.

In most sections of the country, the top dressing period is about concluded and movement of all materials is small at the present. There is no particular price change to be noted on raw materials, although organics generally have firmed up some over the declines of recent weeks.

Export demand still exists for such materials as sulphate of ammonia, ordinary and triple superphosphate but the increasing difficulties in making shipment have retarded any actual business in this direction.

Nitrate of Soda

No change from regular schedule of $27.00 per ton bulk, $28.30 in 200-lb. bags and $29.00 in 100-lb. bags, port basis.

Sulphate of Ammonia

Continues to be scarce as far as new business is concerned and shipments against contract are about finished. Considerable concern is felt as to the abundance of supplies during the coming year.

Superphosphate

Domestic price is still firm at $8.50 per ton for run-of-pile material. The export demand for ordinary superphosphate has fallen off, due to recent shipments of considerable size but there is still call for triple superphosphate in the export market.

Potash

Schedule price of 53½ cents per unit K_2O in bulk, basis ex vessel, still prevails and stocks continue to be ample.

Dried Blood

This market is somewhat stronger with domestic production being quoted at $2.75 ($3.34½ per unit N). South American ground dried blood is being offered for shipment at $2.50 ($3.04 per unit N), c.i.f. Atlantic ports.

Tankage

New York production unground 11/12 per cent material has recently been sold at $2.35 ($2.85½ per unit N) and 10 cents. The last reported sale of foreign high test ground fertilizer tankage was at $2.50 ($3.04 per unit N) and 10 cents c.i.f.

Nitrogenous Material

Domestic material is being quoted at $2.00 per unit of ammonia ($2.43 per unit N) port basis, with no offerings to be had on foreign supplies.

Fish Scrap

Menhaden scrap, new crop, is being quoted at $3.15 ($3.83 per unit N) and 10 cents, f.o.b. producing points, on an "if and when made" basis. The situation on Menhaden meal is very tight, supplies being scarce, but there have been a few offerings at $58.00 per ton, f.o.b. producing points.

Japanese Meakin Meal

Is quoted at $55.00 to $57.00 per ton for limited spot stocks. There are no new seasonal offerings to be had on any Japanese fish meals.

Bone Meal

South American raw bone meal, 4½ and 50 per cent, is being quoted at $31.50 c.i.f. for

June/July shipment, and South American, 3 and 50 per cent, steamed bone meal is offered at $30.00 to $31.00, c.i.f. for same position.

BALTIMORE

Spring Tonnage Estimated to Be Lower Than 1939. War Situation Causes Lower Prices on Organics. Fish Prices Firm.

Exclusive Correspondence to "The American Fertilizer."

BALTIMORE, June 4, 1940.

The spring season is now over, but it is still too early to estimate this year's tonnage as compared with last, but it is generally conceded that it fell short of the 1939 spring season.

Ammoniates.—On account of war conditions in Europe, South American producers are more restricted as to outlet for their products, which has resulted in an easier market on feeding materials. Tankage has eased off, and is now selling at about $2.80 per unit of nitrogen and 10 cents per unit of B.P.L., f.o.b., basis Baltimore, with South American ground dried blood selling at the equivalent of about $3.00 per unit of nitrogen, c.i.f., Baltimore.

Nitrogenous Material.—In sympathy with the easier market on tankage, nitrogenous has eased off, and sales have been made around $2.65 per unit of nitrogen, with very little interest being shown by manufacturers at this time.

Sulphate of Ammonia.—While the season is over, this commodity continues in short supply and re-sale lots are still nominally quoted at around $33.00 per ton, in bulk, f.o.b. Baltimore.

Nitrate of Soda.—There has been no change in the situation and present prices hold good until June 30th as follows: $29.00 per ton of 2,000 lb., in 100-lb. bags; $28.30 in 200-lb. bags; and $27.00 in bulk, f.o.b. port warehouses. This applies on both the domestic as well as imported brands.

Fish Scrap.—In spite of the easier market on feeding materials, fish continues high and there have been further sales reported at the equivalent of $4.25 per unit of nitrogen and 10 cents per unit of B.P.L., f.o.b. fish factory. Japanese sardine meal and 55 per cent menhaden fish meal are both being held at about $58.00 per ton, f.o.b. Baltimore.

Superphosphate.—The market continues unchanged, but manufacturers have not yet quoted prices for future delivery. The market is nominally $8.50 per ton, basis 16 per cent for run-of-pile, and $9.00 per ton for flat 16 per cent, both in bulk, f.o.b. Baltimore.

Potash.—New prices are expected soon, and there is not expected to be much change as compared with last year. Stocks in warehouses are more than ample for current requirements, and manufacturers are not overly concerned regarding the future trend of the market on this ingredient.

Bone Meal.—Offerings continue light, and 3 and 50 per cent domestic ranges from $32.00 to $34.00 per ton, while 4½ and 50 per cent South American is quoted at $31.00 to $32.00 per ton, c.i.f. Baltimore.

Bags.—The market on burlap has been fluctuating considerably during the past few weeks, and while it has been lower, prevailing quotation is around $119.00 per thousand, for 10-oz., basis 50 cut 54 in., bags, for fall delivery.

ATLANTA

Pre-Convention Dullness in Materials Market. Excellent Export Possibilities in Some Materials.

Exclusive Correspondence to "The American Fertilizer."

ATLANTA, June 4, 1940.

Dullness has marked the fertilizer materials picture for the last week or ten days with very few price changes to be reported. It is expected that future prices on various chemicals will be issued at or shortly after the Fertilizer Convention now in session at White Sulphur Springs. Potash prices apparently will not be changed.

This country will evidently have an excellent opportunity for export to various markets formerly supplied from Europe and the extent of this demand is sure to have an influence on the future trend of such items as superphosphate, sulphate of ammonia, etc.

The current markets are quoted as follows:

Dried Blood.—Imported, $2.60 ($3.16 per unit N), c.i.f.

Tankage.—$2.90 ($3.52½ per unit N) and 10 cents.

Fish Scrap.—Menhaden, nothing offered.

Nitrate of Soda.—Spot shipments for top dressing purposes active. No change in price.

Sulphate of Ammonia.—Still scarce, with some export inquiry. No change in price.

Cottonseed Meal.—Easier; futures now quoted around $21.00 to $22.00, Memphis, for 8 per cent. The spot market, however, is relatively much higher.

Steamed Bone.—Scarce. Where obtainable, price around $30.50, c.i.f.

Raw Bone Meal.—4½ and 45 per cent, $31.50, c.i.f.

CHICAGO

Fertilizer Organics Market Dull Because of European Situation. Feed Materials Lower.

Exclusive Correspondence to "The American Fertilizer."

CHICAGO, June 3, 1940.

The ammoniate market is more or less lethargic at this time, owing, no doubt, to the declines and continued uncertainty of commodities in general. That this may change, is the opinion of many, when and if more favorable news is received of the turmoil abroad. It is hoped the usual exchange of views at the Fertilizer Convention may clarify, at least to some extent, the market situation.

In the feed market, a second reduction this month in the list prices of digester and meat scraps (now $45.00) caused sharp declines in materials.

Nominal prices are as follows: High grade ground fertilizer tankage, $2.40 to $2.50 ($2.91½ to $3.04 per unit N) and 10 cents; standard grades crushed feeding tankage, $2.45 to $2.50 ($2.98 to $3.04 per unit N) and 10 cents; blood, $2.50 to $2.60 ($3.04 to $3.16 per unit N); dry rendered tankage, 55 to 60 cents per unit of protein, Chicago basis.

PHILADELPHIA

Market at Standstill During Convention Week. Price Quotations Nominal.

Exclusive Correspondence to "The American Fertilizer."

PHILADELPHIA, June 4, 1940.

The fertilizer materials market is practically at a standstill, due no doubt to the Fertilizer Convention at White Sulphur Springs this week. There is no interest whatever displayed in any offerings, and consequently price quotations are nominal to a great extent.

Nitrate of Soda.—Price remains the same. Contract deliveries fair.

Sulphate of Ammonia.—Price firm. Demand not so great as during the past month.

Dried Blood.—Nominally at $2.75 ($3.34½ per unit N). Not much interest being shown by buyers.

Tankage.—Easier. Nominal price $2.75 ($3.34½ per unit N) and 10 cents.

Bone Meal.—3 and 50 per cent offered about $33.00; 4½ and 45 per cent at $36.00 to $37.00.

Superphosphate.—Price remains the same. Little demand.

Potash.—Syndicate schedule prevails.

TENNESSEE PHOSPHATE

Summer Lull Arrives. Prospects Good for Year 1940. Mining and Metallurgical Engineers to Hold Meeting.

Exclusive Correspondence to "The American Fertilizer."

COLUMBIA, TENN., June 3, 1940.

The summer lull has come in phosphate rock shipments in all lines, but business still holds up better than during 1939, with every indication that 1940 will be another record year in both production and consumption. Just at present the backwash, into the consuming area served by Tennessee phosphate, from the export tonnage lost to Florida by the war still affects prices and demand to some extent, but it is already obvious that increased domestic demand is rapidly overcoming that situation, and just as was the effect of the last world war, fantastic price increases and shipping difficulties may soon be expected. Wise farmers who already know from years of experience the value of finely ground phosphate rock, and the difficulty of getting it when the fertilizer fac-

tories buy up the supply in large contracts at boom prices, are planning to purchase now during the lull season, instead of waiting until usual season of fall activity. Users of that form of fertilizer have the advantage of being able to apply it any time of the year.

There is much interest in the meeting to be held here June 21st and 22nd of the American Institute of Mining and Metallurgical Engineers, with visits to two plants near Columbia, a dinner meeting at Nashville on the 21st, when papers on the geology, mining, milling, and use of phosphate will be given, and on the 22nd, visits to four operations at Mt. Pleasant, with a fish fry luncheon at Arrow Lake near Mt. Pleasant. There are only six members of the American Institute of Mining and Metallurgical Engineers in the phosphate district, but they are being actively assisted by representatives of all the mining and manufacturing companies of the industry and by Dr. W. F. Pond, State Geologist of Nashville who is looking after all Nashville arrangements. Mr. H. R. Mosely, head of the local phosphate department of the TVA, is Chairman of the Committee on Arrangements.

In addition to the engineers, a number of prominent fertilizer people interested in phosphate mining will be present, and the fish fry and other local expense is being cared for by the local phosphate companies.

FARM COOPERATIVES INCREASING

The growth of farmers' cooperative purchasing associations in this country is pictured in a recent report of the Farm Credit Administration. In 1913, there were 111 such organizations, whose purchases amounted to about $6,000.000. By 1930, the figures show 1,588 associations with purchases of $215,000,000. In the fiscal year 1938-39, there were 2,600 associations with 890,000 members, and purchases of $335,000,000.

SULPHUR PRODUCTION, 1939

Production of sulphur in the United States in 1939 decreased to 2,090,979 long tons, or 13 per cent, compared with the output in 1938 of 2,393,408 tons, according to the Bureau of Mines. Shipments increased 37 per cent in 1939 and amounted to 2,233,817 long tons, valued at about $35,500,000, compared with 1,628,847 tons, valued at about $27,300,000 in 1938. Stocks at the mines on December 31, 1939, had decreased to 4,000.000 long tons, or 200,000 tons below the reserve at the close of the preceding year. Production of sulphur was reported from California, Louisiana, Texas and Utah. Exports in 1939 totaled 627,819 long tons.

DR. O. C. MAGISTAD APPOINTED ASSISTANT CHIEF PLANT INDUSTRY

On June 1st, Dr. E. C. Auchter, Chief of the Bureau of Plant Industry, announced the appointment of Dr. O. C. Magistad, as Assistant Chief of the Bureau. Doctor Magistad has been in charge of the U. S. Regional Salinity Laboratory at Riverside, California, since 1938, and will give special attention to the soils investigations of the Bureau. He will be succeeded by Dr. R. H. Walker, dean of the College of Agriculture and director of the Utah Agricultural Experiment Station, at Logan.

Doctor Magistad has had wide experience in soils investigations in the United States, Central America and the Hawaiian Islands. He received his under-graduate and graduate training in soils at the University of Wisconsin and holds a Ph. D. degree from that institution.

Since 1938 Doctor Magistad has been director of the U. S. Bankhead-Jones Regional Salinity Laboratory at Riverside, California. In this position he has arranged cooperative ex-

perimental work with eleven western states relative to the effect of salinity of irrigation water upon plant growth and the physical composition of the soil. He has published the results of soils research in various scientific journals of this country and in various experiment station bulletins in the United States and Hawaii.

"Because of Doctor Magistad's wide experience in both plant and soils research in this and other countries," said Doctor Auchter, "he is especially well equipped to assist in the administrative work concerned with plant and soils research."

THE RELATIONSHIP OF LIMING TO SOIL FERTILIZATION

(Continued from page 8)

growth and thus return more plant debris to the soil, which finally becomes soil organic matter. Furthermore, legumes are encouraged, which makes for more organic matter in the soil. This, in turn, improves the physical aspects of the soil by stimulating deep rooted legumes which tend to make the soil more mellow.

Improving the Physical Aspects of the Soil

In studying the influence of salt water flooding of soil, it was found that lime increased the rapidity with which water leached through these soils. Since some sodium is added through fertilizers to most soils, lime tends to stabilize the colloid against leaching into the subsoil and interfering with internal drainage. Further, in leaching studies on average soils, it was found through experiments that liming increased the rate of percolation of water through the soils.

One misconception of the movement of lime in the soil needs to be mentioned. Many growers feel that lime leaches into the soil readily and corrects the acidity. This has not been found to be entirely true. In studying a Bladen sandy loam near Norfolk, Virginia, on which spinach had grown for 40 years and which had

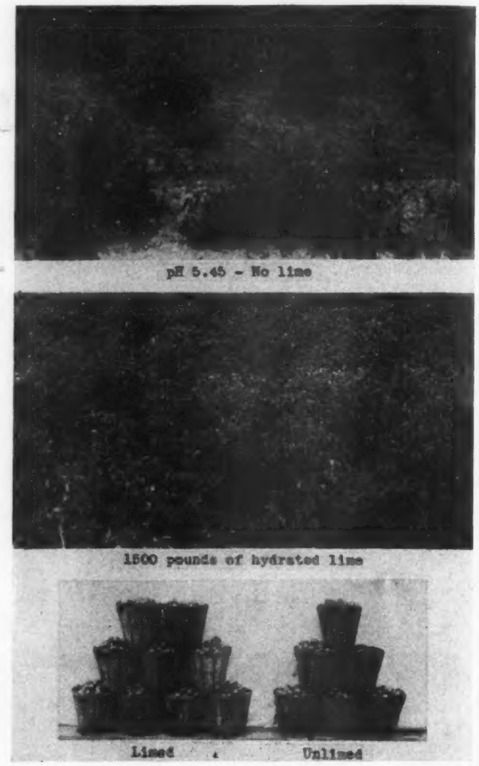


FIG. 9. Influence of lime on the growth and yield of tomatoes.

been trucked for 80 years, it was learned that lime had not penetrated below the 0 to 7 inch horizon or plow depth of the soil to correct the soil acidity. This is shown in Table VII. Now, if the plant food stored in the acid subsoil is to be regained by the plants, liming of the subsoil or immediately above the subsoil must be practiced. In studying a potash problem a Sassafras sandy soil was packed into a "coffee-urn lining" pot, 6 inches of acid subsoil and 6 inches

Table VII

Lime Added to Topsoil is Slow to Neutralize Subsoil

Horizon		Virgin pH	Cropped* pH
A_1	0-7	4.7	6.1
A_2	8-21	4.65	4.9
B	22-36	4.65	4.7
C	36-	4.85	4.8

* Soil limed and spinach grown intermittently for 40 years, Bladen sandy loam, Norfolk, Va.

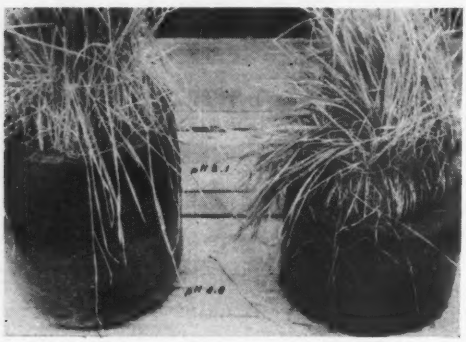


Fig. 10. Lack of root penetration in acid subsoil by rye.

of topsoil limed to pH 6.1. Then muriate of potash was added and the soil leached free of chlorides. It was found that much of the potash leached into and was absorbed by the subsoil. Crops grown upon this soil after leaching took out only the potash in the topsoil, Fig. 10. Upon examination it was found that roots from even rye had not penetrated the subsoil. For proper root growth in acid soils, subsoil liming is desirable. This has never been done in the States to any extent and should be greatly encouraged. Finally, liming soils should be encouraged because it increases the calcium and magnesium content of the products grown upon the soil.

Liming Increases Calcium and Magnesium

The data in Table VIII show the influence of liming upon increasing the calcium and magnesium content of some common vegetables. Since plants that have a high calcium content

Table VIII

The Influence of Lime Upon the Calcium and Magnesium Content of Vegetable Crops*

	Collards		Spinach			Lima Beans Vegetation		Beets Tops	
pH of Soil	CaO	MgO	CaO	MgO	pH of Soil	CaO	MgO	CaO	MgO
5.0	2.5	0.6	2.8	1.2	4.0	1.0	0.6	1.4	0.7
5.5	3.1	0.7	3.3	1.3	5.1	4.4	0.6	1.6	0.9
5.7	3.1	0.8	3.4	1.4	6.1	5.6	0.7	1.7	0.9
5.8	3.1	0.8	3.4	1.4	6.8	5.7	0.8	1.8	1.0
					7.0	6.8	0.8	1.9	0.9

* Percentage on dry weight basis.

are encouraged in the animal diet, certainly increasing the calcium content of the readily consumed crops is desirable.

In recent literature much emphasis has been placed upon the calcium and phosphate requirement of the animal body. The matter of increasing the calcium and magnesium content of forage and vegetable crops can be hardly overemphasized.

Finally, every effort should be made to encourage properly liming soils. Since there are so many acid soils and since the subsoil of these soils has such a high lime requirement it is not likely that over-liming is apt to become a factor where proper methods of application are followed.

BUYERS' GUIDE

A CLASSIFIED INDEX TO ALL THE ADVERTISERS IN "THE AMERICAN FERTILIZER"

This list contains representative concerns in the Commercial Fertilizer Industry, including fertilizer manufacturers, machinery and equipment manufacturers, dealers in and manufacturers of commercial fertilizer materials and supplies, brokers, chemists, etc.
For Alphabetical List of Advertisers, see page 33.

ACID BRICK
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.

ACID EGGS
Chemical Construction Corp., New York City.

ACIDULATING UNITS
Chemical Construction Corp., New York City.
Sackett & Sons Co., The A. J., Baltimore, Md.

AMMO-PHOS
American Cyanamid Co., New York City.

AMMONIA—Anhydrous
Barrett Company, The, New York City.
Du Pont de Nemours & Co., E. I., Wilmington, Del.
Hydrocarbon Products Co., New York City.

AMMONIA LIQUOR
Barrett Company, The, New York City.
Du Pont de Nemours & Co., E. I., Wilmington, Del.
Hydrocarbon Products Co., New York City.

AMMONIA OXIDATION UNITS
Chemical Construction Corp., New York City.

AMMONIATING EQUIPMENT
Sackett & Sons Co., The A. J., Baltimore, Md.

APPARATUS—Laboratory
Sturtevant Mill Co., Boston, Mass.

AUTOMATIC ELEVATOR TAKEUPS
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

BABBITT
Sackett & Sons Co., The A. J., Baltimore, Md.

BAGS AND BAGGING—Manufacturers
Bagpak, Inc., New York City.
Bemis Bro. Bag Co., St. Louis, Mo.

BAGS—Cotton
Bemis Bro. Bag Co., St. Louis, Mo.

BAGS—Paper
Bagpak, Inc., New York City.
Bemis Bro. Bag Co., St. Louis, Mo.

BAGS (Waterproof)—Manufacturers
Bemis Bro. Bag Co., St. Louis, Mo.

BAGS—Dealers and Brokers
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
Taylor, Henry L., Wilmington, N. C.
Wellmann, William E., Baltimore, Md.

BAGGING MACHINES—For Filling Sacks
Atlanta Utility Works, East Point, Ga.
Bagpak, Inc., New York City.
Sackett & Sons Co., The A. J., Baltimore, Md.
Sturtevant Mill Co., Boston, Mass.

BAG-CLOSING MACHINES
Bagpak, Inc., New York City.

BAG PILERS
Link-Belt Company, Philadelphia, Chicago.

BEARINGS
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

BELT LACING
Sackett & Sons Co., The A. J., Baltimore, Md.

BELTING—Chain
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

BELTING—Leather, Rubber, Canvas
Sackett & Sons Co., The A. J., Baltimore, Md.
Sturtevant Mill Co., Boston, Mass.

BOILERS—Steam
Atlanta Utility Works, East Point, Ga.

BONE BLACK
American Agricultural Chemical Co., New York City.
Armour Fertilizer Work, Atlanta, Ga.
Huber & Company, New York City.

BONE PRODUCTS
American Agricultural Chemical Co., New York City.
Armour Fertilizer Work, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

BORAX AND BORIC ACID
American Potash and Chem. Corp., New York City.
Pacific Coast Borax Co., New York City.

BROKERS
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Burns & Company, L. D., Atlanta, Ga.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
Keim, Samuel L., Philadelphia, Pa.
Schmaltz, Jos. H., Chicago, Ill.
Taylor, Henry L., Wilmington, N. C.
Wellmann, William E., Baltimore, Md.

BUCKETS—Elevator
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

A Classified Index to Advertisers in "The American Fertilizer"

BUYERS' GUIDE

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BUCKETS—For Hoists, Cranes, etc., Clam Shell, Orange Peel, Drag line, Special; Electrically Operated and Multi Power
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.

BURNERS—Sulphur
Chemical Construction Corp., New York City.

BURNERS—Oil
Monarch Mfg. Works, Inc., Philadelphia, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.

CABLEWAYS
Hayward Company, The, New York City.

CALCIUM-NITRATE
Synthetic Nitrogen Products Co., New York City.

CAL-NITRO
Synthetic Nitrogen Products Co., New York City.

CARBONATE OF AMMONIA
American Agricultural Chemical Co., New York City.
Du Pont de Nemours & Co., E. I., Wilmington, Del.

CARS—For Moving Materials
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CARTS—Fertilizer, Standard and Roller Bearing
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

CASTINGS—Acid Resisting
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.

CASTINGS—Iron and Steel
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CEMENT—Acid-Proof
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.

CHAIN DRIVES—Silent
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CHAINS AND SPROCKETS
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CHAMBERS—Acid
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.

CHEMICAL APPARATUS
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

CHEMICALS
American Agricultural Chemical Co., New York City.
American Cyanamid Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Barrett Company, The, New York City.
Bradley & Baker, New York City.
Du Pont de Nemours & Co., E. I., Wilmington, Del.

CHEMICALS—Continued
Huber & Company, New York City.
Wellmann, William E., Baltimore, Md.

CHEMICAL PLANT CONSTRUCTION
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

CHEMISTS AND ASSAYERS
Gascoyne & Co., Baltimore, Md.
Shuey & Co., Savannah, Ga.
Stillwell & Gladding, New York City.
Wiley & Company, Baltimore, Md.

CLUTCHES
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CONCENTRATORS—Sulphuric Acid
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.

CONDITIONERS AND FILLERS
American Limestone Co., Knoxville, Tenn.

CONTACT ACID PLANTS
Chemical Construction Corp., New York City.

COPPER SULPHATE
Tennessee Corporation, Atlanta, Ga.

COTTONSEED PRODUCTS
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Taylor, Henry L., Wilmington, N. C.
Wellmann, William E., Baltimore, Md.

CRANES AND DERRICKS
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Link-Belt Speeder Corp., Chicago, Ill. and Cedar Rapids, Iowa.
Sackett & Sons Co., The A. J., Baltimore, Md.

CYANAMID
American Agricultural Chemical Co., New York City.
American Cyanamid Co., New York City.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Jett, Joseph C., Norfolk, Va.
Taylor, Henry L., Wilmington, N. C.
Wellmann, William E., Baltimore, Md.

DENS—Superphosphate
Chemical Construction Corp., New York City.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

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Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

DOUBLE SUPERPHOSPHATE (See Superphosphate—Concentrated)

DRYERS—Direct Heat
Sackett & Sons Co., The A. J., Baltimore, Md.

DRIVES—Electric
Link-Belt Company, Philadelphia, Chicago.

DUMP CARS
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

DUST COLLECTING SYSTEMS
Sackett & Sons Co., The A. J., Baltimore, Md.
Sturtevant Mill Co., Boston, Mass.

ELECTRIC MOTORS AND APPLIANCES
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

ELEVATORS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

ELEVATORS AND CONVEYORS—Portable
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Sturtevant Mill Co., Boston, Mass.

ENGINEERS—Chemical and Industrial
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

ENGINES—Steam
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

EXCAVATORS AND DREDGES—Drag Line and Cableway
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Link-Belt Speeder Corp., Chicago, Ill. and Cedar Rapids, Iowa.

FERTILIZER MANUFACTURERS
American Agricultural Chemical Co., New York City.
American Cyanamid Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Farmers Fertilizer Co., Columbus, Ohio.
International Agricultural Corp., New York City.
Smith-Rowland Co., Norfolk, Va.
U. S. Phosphoric Products Corp., New York City.

FISH SCRAP AND OIL
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
Taylor, Henry L., Wilmington, N. C.
Wellmann, William E., Baltimore, Md.

FOUNDERS AND MACHINISTS
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Link-Belt Company, Philadelphia, Chicago.

FOUNDERS AND MACHINISTS—Continued
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

GARBAGE TANKAGE
Wellmann, William E., Baltimore, Md.

GEARS—Machine Moulded and Cut
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

GEARS—Silent
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

GELATINE AND GLUE
American Agricultural Chemical Co., New York City.

GUANO
Baker & Bro., H. J., New York City.

HOISTS—Electric, Floor and Cage Operated, Portable
Hayward Company, The, New York City.

HOPPERS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

IMPORTERS, EXPORTERS
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Wellmann, William E., Baltimore, Md.

IRON SULPHATE
Tennessee Corporation, Atlanta, Ga.

INSECTICIDES
American Agricultural Chemical Co., New York City.

LACING—Belt
Sackett & Sons Co., The A. J., Baltimore, Md.

LIMESTONE
American Agricultural Chemical Co., New York City.
American Limestone Co., Knoxville, Tenn.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Wellmann, William E., Baltimore, Md.

LOADERS—Car and Wagon, for Fertilizers
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Acid Making
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Monarch Mfg. Works, Inc., Philadelphia, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

MACHINERY—Coal and Ash Handling
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Elevating and Conveying
Atlanta Utility Works, East Point, Ga.
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
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Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

MACHINERY—Power Transmission
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

MACHINERY—Pumping
Atlanta Utility Works, East Point, Ga.

MACHINERY—Tankage and Fish Scrap
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

MAGNESIA
California Chemical Co., New York City.

MAGNETS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MANGANESE SULPHATE AND CARBONATE
Tennessee Corporation, Atlanta, Ga.

MANGANESE SULPHATE
Tennessee Corportion, Atlanta, Ga.

MIXERS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

NITRATE OF SODA
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Barrett Company, The, New York City.
Bradley & Baker, New York City.
Chilean Nitrate Sales Corp., New York City.
Huber & Company, New York City.
International Agricultural Corp., New York City.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

NITRATE OVENS AND APPARATUS
Chemical Construction Corp., New York City.

NITROGENOUS ORGANIC MATERIAL
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Du Pont de Nemours & Co., E. I., Wilmington, Del.
Huber & Company, New York City.
International Agricultural Corp., New York City.
Smith-Rowland Co., Norfolk, Va.
Wellmann, William E., Baltimore, Md.

NOZZLES—Spray
Monarch Mfg. Works, Inc., Philadelphia, Pa.

PACKING—For Acid Towers
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.

PANS AND POTS
Stedman's Foundry and Mach. Works, Aurora, Ind.

PHOSPHATE MINING PLANTS
Chemical Construction Corp., New York City.

PHOSPHATE ROCK
American Agricultural Chemical Co., New York City.
American Cyanamid Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Charleston Mining Co., Inc., Richmond, Va.
Huber & Company, New York City.
International Agricultural Corp., New York City.
Jett, Joseph C., Norfolk, Va.
Ruhm, H. D., Mount Pleasant, Tenn.
Schmaltz, Jos. H., Chicago, Ill.
Southern Phosphate Corp., Baltimore, Md.
Taylor, Henry L., Wilmington, Del.
Wellmann, William E., Baltimore, Md.

PIPES—Chemical Stoneware
Chemical Construction Corp., New York City.

PIPES—Wooden
Stedman's Foundry and Mach. Works, Aurora, Ind.

PLANT CONSTRUCTION—Fertilizer and Acid
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

POTASH SALTS—Dealers and Brokers
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Agricultural Corp., New York City.
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Synthetic Nitrogen Products Co., New York City.
Taylor, Henry L., Wilmington, Del.
Wellmann, William E., Baltimore, Md.

POTASH SALTS—Manufacturers and Importers
American Potash and Chem. Corp., New York City.
Potash Co. of America, Baltimore, Md.
United States Potash Co., New York City.

PULLEYS AND HANGERS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Co., Boston, Mass.

PUMPS—Acid-Resisting
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

PYRITES—Brokers
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Jett, Joseph C., Norfolk, Va.
Wellmann, William E., Baltimore, Md.

QUARTZ
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.

RINGS—Sulphuric Acid Tower
Chemical Construction Corp., New York City.

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- Bradley & Baker, New York City.
- Schmaltz, Jos. H., Chicago, Ill.
- Wellmann, William E., Baltimore, Md.

SCALES—Including Automatic Bagging
- Atlanta Utility Works, East Point, Ga.
- Sackett & Sons Co., The A. J., Baltimore, Md.
- Stedman's Foundry and Mach. Works, Aurora, Ind.

SCRAPERS—Drag
- Hayward Company, The, New York City.
- Link-Belt Company, Philadelphia, Chicago.

SCREENS
- Atlanta Utility Works, East Point, Ga.
- Link-Belt Company, Philadelphia, Chicago.
- Sackett & Sons Co., The A. J., Baltimore, Md.
- Stedman's Foundry and Mach. Works, Aurora, Ind.
- Sturtevant Mill Co., Boston, Mass.

SEPARATORS—Air
- Sackett & Sons Co., The A. J., Baltimore, Md.
- Sturtevant Mill Co., Boston, Mass.

SEPARATORS—Including Vibrating
- Link-Belt Company, Philadelphia, Chicago.
- Sackett & Sons Co., The A. J., Baltimore, Md.
- Sturtevant Mill Co., Boston, Mass.

SEPARATORS—Magnetic
- Sackett & Sons Co., The A. J., Baltimore, Md.
- Stedman's Foundry and Mach. Works, Aurora, Ind.

SHAFTING
- Atlanta Utility Works, East Point, Ga.
- Link-Belt Company, Philadelphia, Chicago.
- Sackett & Sons Co., The A. J., Baltimore, Md.
- Stedman's Foundry and Mach. Works, Aurora, Ind.

SHOVELS—Power
- Link-Belt Company, Philadelphia, Chicago.
- Link-Belt Speeder Corp., Chicago, Ill. and Cedar Rapids, Iowa.
- Sackett & Sons Co., The A. J., Baltimore, Md.

SPRAYS—Acid Chambers
- Monarch Mfg. Works, Inc., Philadelphia, Pa.

SPROCKET WHEELS (See Chains and Sprockets)

STACKS
- Sackett & Sons Co., The A. J., Baltimore, Md.

SULPHATE OF AMMONIA
- American Agricultural Chemical Co., New York City.
- Armour Fertilizer Works, Atlanta, Ga.
- Ashcraft-Wilkinson Co., Atlanta, Ga.
- Baker & Bro., H. J., New York City.
- Barrett Company, The, New York City.
- Bradley & Baker, New York City.
- Huber & Company, New York City.
- Hydrocarbon Products Co., New York City.
- Jett, Joseph C., Norfolk, Va.
- Schmaltz, Jos. H., Chicago, Ill.
- Snythetic Nitrogen Products Co., New York City.
- Taylor, Henry L., Wilmington, N. C.
- Wellmann, William E., Baltimore, Md.

SULPHUR
- Ashcraft-Wilkinson Co., Atlanta, Ga.
- Baker & Bro., H. J., New York City.
- Freeport Sulphur Co., New York City.
- Texas Gulf Sulphur Co., New York City.

SULPHURIC ACID
- American Agricultural Chemical Co., New York City.
- Armour Fertilizer Works, Atlanta, Ga.
- Ashcraft-Wilkinson Co., Atlanta, Ga.
- Baker & Bro., H. J., New York City.

SULPHURIC ACID—Continued
- Bradley & Baker, New York City.
- Huber & Company, New York City.
- Jett, Joseph C., Norfolk, Va.
- Taylor, Henry L., Wilmington, N. C.
- U. S. Phosphoric Products Corp., New York City.
- Wellmann, William E., Baltimore, Md.

SUPERPHOSPHATE
- American Agricultural Chemical Co., New York City.
- Armour Fertilizer Works, Atlanta, Ga.
- Ashcraft-Wilkinson Co., Atlanta, Ga.
- Baker & Bro., H. J., New York City.
- Bradley & Baker, New York City.
- Huber & Company, New York City.
- International Agricultural Corp., New York City.
- Jett, Joseph C., Norfolk, Va.
- Schmaltz, Jos. H., Chicago, Ill.
- Taylor, Henry L., Wilmington, N. C.
- U. S. Phosphoric Products Corp., New York City.
- Wellmann, William E., Baltimore, Md.

SUPERPHOSPHATE—Concentrated
- Armour Fertilizer Works, Atlanta, Ga.
- International Agricultural Corp., New York City.
- U. S. Phosphoric Products Corp., New York City.

SYPHONS—For Acid
- Monarch Mfg. Works, Inc., Philadelphia, Pa.

TALLOW AND GREASE
- American Agricultural Chemical Co., New York City.

TANKAGE
- American Agricultural Chemical Co., New York City.
- Armour Fertilizer Works, Atlanta, Ga.
- Ashcraft-Wilkinson Co., Atlanta, Ga.
- Baker & Bro., H. J., New York City.
- Bradley & Baker, New York City.
- International Agricultural Corp., New York City.
- Jett, Joseph C., Norfolk, Va.
- Schmaltz, Jos. H., Chicago, Ill.
- Smith-Rowland Co., Norfolk, Va.
- Taylor, Henry L., Wilmington, N. C.
- Wellmann, William E., Baltimore, Md.

TANKAGE—Garbage
- Huber & Company, New York City.

TANKS
- Sackett & Sons Co., The A. J., Baltimore, Md.

TILE—Acid-Proof
- Charlotte Chem. Laboratories, Inc., Charlotte, N. C.

TOWERS—Acid and Absorption
- Chemical Construction Corp., New York City.
- Fairlie, Andrew M., Atlanta, Ga.

UNLOADERS—Car and Boat
- Hayward Company, The, New York City.
- Link-Belt Company, Philadelphia, Chicago.
- Sackett & Sons Co., The A. J., Baltimore, Md.

UREA
- Du Pont de Nemours & Co., E. I., Wilmington, Del.
- Snythetic Nitrogen Products Co., New York City.

UREA-AMMONIA LIQUOR
- Du Pont de Nemours & Co., E. I., Wilmington, Del.

VALVES—Acid-Resisting
- Atlanta Utility Works, East Point, Ga.
- Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
- Monarch Mfg. Works, Inc., Philadelphia, Pa.

WHEELBARROWS (See Carts)

ZINC SULPHATE
- Tennessee Corporation, Atlanta, Ga.

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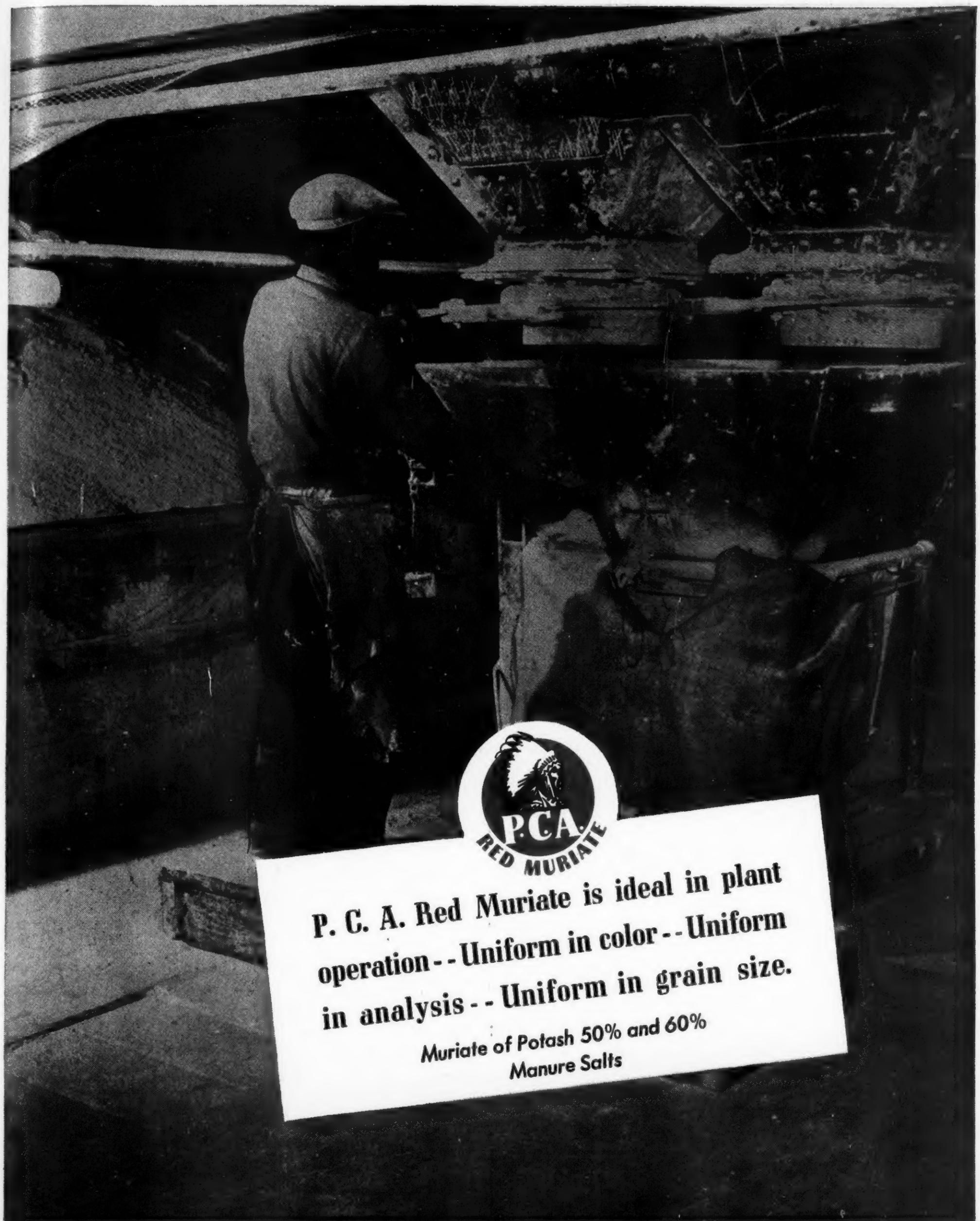

POTASH COMPANY
of America

GENERAL SALES OFFICE
MERCANTILE TRUST BUILDING BALTIMORE, MARYLAND

SOUTHERN SALES OFFICE
MORTGAGE GUARANTEE BUILDING
ATLANTA, GEORGIA

Flexibility with Barrett Standard Nitrogen Solutions

BARRETT Standard Nitrogen Solutions offer fertilizer manufacturers flexibility of use in the ammoniation of superphosphates and superphosphate mixtures — of great importance under present abnormal conditions —:

1. Low cost per Unit Nitrogen.
2. Desirable ratios of Nitrate to Ammonia Nitrogen. (For maximum crop growing powers).
3. Stable base mixtures (from 3-17-0 to 6-15-0), which blend well to form mixtures containing an effective range of N to P_2O_5 ratios.
4. Rapid curing, non-dusty, non-segregating, granular mixed fertilizers.

The services of our technicians are available to you on request.

THE BARRETT COMPANY • *Headquarters for Nitrogen*

NEW YORK, N. Y.

HOPEWELL, VA.	COLUMBIA, S. C.	MONTGOMERY, ALA.	MEMPHIS, TENN.
RALEIGH, N. C.	ATLANTA, GA.	NEW ORLEANS, LA.	SAN FRANCISCO, CAL.

Barrett NITROGEN